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PATENT SPECIFICATION

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(19)

(54) IMPROVEMENTS IN OR RELATING TO PRESSURE EQUALISING ARRANGEMENTS

(71) We, ROTORK LIMITED, a British Company, of Brassmill Lane, Lower Weston, Bath, Somerset, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to arrangements for equalising the pressure between two locations, at least one of which is subject to pressure variations in the conditions prevailing therein, and which include a common structure extending therebetween.

In particular, the invention relates to the provision of pressure equalising arrangements between two locations, at least one of which comprises a sealed housing or vessel subject to pressure variations in the conditions prevailing therein and which includes a shaft assembly extending therefrom into the other location.

The second location need not be sealed and could be the atmosphere as would be the case in the application of the invention to the sealed fluid-tight chamber of a hydraulic gear box. The invention is, however, more particularly applicable to assemblies where the second location is also a sealed housing or vessel but which is not normally subject to any substantial pressure variations in the conditions prevailing therein. A particular example of such an arrangement is an electro-hydraulic actuator, e.g. as described in our co-pending Patent Application No. 42352/70 (Serial No. 1,357,529) in which an electric motor is drivably connected by a shaft assembly with an hydraulic pump for providing the pressure fluid for operating the hydraulic servo motor connected to the output member. The electric motor is located in a sealed housing with the other electrics of the actuator, while the hydraulic pump is located in a second housing which provides a reservoir and is sealed so as to enable the actuator to be mounted in any desired position. The shaft assembly extends through a partition wall between the housings and to compensate for expansion and/or contraction of the hydraulic fluid in the second housing some means, such as a gas-filled bladder, is provided in the reservoir.

An object of the present invention is to provide a pressure equalising arrangement which will substantially eliminate pressure differentials across the shaft assembly due to differences in the pressures prevailing in the two housings. The provision of such a pressure equalising arrangement greatly simplifies the seals required for the shaft assembly while compensating for the expansion and/or contraction of the hydraulic fluid in the sealed housing.

According to the invention there is provided a pressure equalising arrangement for eliminating pressure differentials across a common shaft assembly extending into two locations, one of which is a sealed housing or vessel containing a hydraulic fluid subject to pressure variations and the other of which is a second housing or vessel containing air, wherein a sealed bladder or bellows is located in said first sealed housing or vessel and is deformable in response to expansion or contraction of said hydraulic fluid therein, and the interior of said bladder or bellows is directly connected to the second housing or vessel for the flow of fluid to and from the second housing or vessel in response to expansion or contraction of said bladder or bellows.

In a preferred embodiment of the invention the pressure equalising means comprises a sealed bellows mounted in an actuator for eliminating pressure differentials across a shaft extending between two housings one of which contains an electric motor while the other contains an hydraulic pump which is drivingly connected with the electric motor by the shaft. The bellows is mounted in the pump housing which contains an hydraulic fluid and the interior of the bellows communicates with the interior of the motor housing by a connector mounted in the common wall between the housings and

which provides a sealed flameproof path for the flow of air to and from the motor housing as the bladder contracts or expands in response to expansion or contraction of the volume of hydraulic fluid in the pump housing. In this way the hydraulic fluid in the pump housing can expand or contract with variations in temperature without causing a pressure differential across the seals etc. of the shaft assembly.

The invention will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a simplified layout of an electro-hydraulic actuator of the kind described in our copending Patent Application No. 42352/70 (Serial No. 1,357,529) and which is fitted with the pressure equalising arrangement of the invention, and

Figure 2 is an enlarged view of the flameproof connector for the pressure equalising arrangement of Figure 1.

Referring to the drawings the actuator shown is basically electro-hydraulically operated, the mechanism being contained in a casing which comprises a first or main housing 10 which for convenience is shown in the drawing as being positioned vertically, but as will be hereinafter explained can be located in any desired position. The housing contains an hydraulic servo-unit or motor 11 consisting of a piston 12 which is slidably mounted in annular wall 13 of the housing 10. The piston 12 is connected to or formed integrally with an output member for the actuator. The output member comprises a shaft 14 which extends across the housing 10 and projects at one end through the end mounting face 15 and at the other end through the end mounting face 16. The projecting ends of the shaft 14 are provided with connections 17 for coupling one or other end of the shaft to the member to be controlled such as a valve (not shown). The shaft may be connected at either end depending on the direction of control and/or the mounting of the actuator.

The housing 10 is completely filled with a hydraulic fluid and the ends of the shaft 14 extend through the end faces 15, 16 of the housing in sealing-tight manner by the provision of suitable sealing rings 18. The housing 10 is sealed so as to permit the mounting of the actuator in an inverted or any other position.

The housing 10 contains an hydraulic pump 19 which when operable pumps hydraulic fluid through passageway 20 to the high pressure chamber 21 in the cylinder 13 between the piston 12 and end mounting face 16 of the housing. The piston 12 on its low pressure side is provided with an annular skirt 22 which acts as a support for one end of a heavy coiled compression spring 23 the other end of which seats on a retainer 24.

The pump 19 is operable to move the output shaft 14 upwardly as shown against the action of the spring 23 which acts to return the output shaft downwardly when the pump is inoperable and the chamber 21 is connected to the low pressure side of the piston 12. The low pressure side of the piston provides an hydraulic fluid reservoir which is subject to expansion and contraction in response to temperature changes. Such expansion and contraction of fluid in the sealed housing 10 results in pressure changes in the housing which are compensated by the provision of a deformable bag in the form of a bladder or bellows 25 made of rubber or like material and which is supported by retainer 24 in an extension 26 of the housing 10. The bladder or bellows 25 also provides a device, as will be hereinafter explained, for equalising the pressure between housing 10 and a second housing 27 which is mounted transversely on housing 10.

The housing 27 contains a gaseous fluid, such as air, and its interior is directly connected with the interior of the bladder or bellows 25 by means of a flexible hose 28 which is connected at one end to the bladder or bellows 25 and at the other end to a connector 29 mounted, as will be hereinafter described, in the partition wall 30 forming part of the housing 27. The housing 27 is provided with a closure portion 31 and the housing contains electric induction motor 32 which is drivably connected with the pump 19 by means of a shaft assembly 33 which extends through the partition wall 30 in an elongated mounting 34 projecting from wall 30 into the housing 27.

The function of the bladder or bellows 25 in equalising the pressures in the housings 10 and 27 has the advantage of eliminating any pressure differentials over the shaft assembly 33 which might occur between the housings due to expansion and contraction of the hydraulic fluid in housing 10 due to temperature changes. The invention thus enables a simple mounting to be provided for the shaft assembly without the necessity of complicated pressure seals. As shown, the shaft 33 is mounted in spaced bearings 35, 36 in mounting 34 which is fitted with an end seal 37 for fluid tightness.

The connector 29 in wall 30 is shown more clearly in Figure 2 and provides a flameproof path for the flow of air between the interior of bladder or bellows 25 and the interior of housing 27. To this end, the connector 29 comprises an elongated sleeve 38 which is mounted in an apertured boss 39 in wall 30. The sleeve 38 has a central passageway 40 stepped to provide three

sections having different diameters. The section of smallest diameter at one end communicates directly with the interior of the housing 27 while the section of largest diameter at the other end of the sleeve is adapted to receive one end of a coupling 41 the other end of which receives the end of hose 28. The coupling is retained in the sleeve by a retainer 42 which is threadably attached to the sleeve.

The sleeve 38 is stepped also on its outer surface to provide a shoulder 43 engaging the wall 30 in housing 10 and the sleeve is fixedly mounted in the wall 30 by means of a nut 44 threadably attached on the sleeve at its other end in housing 27. The connector 29 is completed by a fine bore filter 45 located in the section of the passageway 40 of intermediate diameter.

In the event of expansion or contraction of the hydraulic fluid in the reservoir of housing 10 as a result of temperature changes, the bladder or bellows 25 in the reservoir will contract or expand so as to expel or withdraw air into or from the electrical housing 27.

The compensating change in the pressure in the air in the electrical enclosure will result in a substantial equalisation of the pressure differential across the shaft 33 and/or control rods extending through the common partition wall 30. The arrangement thus allows for variations in the pressure in the hydraulic fluid without causing any substantial pressure differential across the seals on the shafts and/or control rods extending through the common partition wall 30 between the two sealed housings 10 and 27.

WHAT WE CLAIM IS:—

1. A pressure equalising arrangement for eliminating pressure differentials across a common shaft assembly extending into two locations, one of which is a sealed housing or vessel containing an hydraulic fluid subject to pressure variations and the other of which is a second housing or vessel containing air, wherein a sealed bladder or bellows is located in said first sealed housing or vessel and is deformable in response to expansion or contraction of said hydraulic fluid therein, and the interior of said bladder or bellows is directly connected to the second housing or vessel for the flow of fluid to and from the second housing or vessel in response to expansion or contraction of said bladder or bellows.

2. An arrangement as claimed in Claim 1, wherein the shaft assembly extends through a common partition between the two housings or vessels and the interior of the sealed bladder or bellows is connected with the interior of said second housing or vessel by means of a connector mounted in the partition wall.

3. An arrangement as claimed in Claim 2, wherein the second housing or vessel is also sealed and contains an electric motor drivingly connected by said shaft assembly with an hydraulic pump in said first sealed housing or vessel, said first sealed housing or vessel forming an hydraulic reservoir for said pump which is operable to actuate a servo motor, and said connector including a flameproof path for the passage of air therethrough.

4. An electro-hydraulic actuator including a pressure equalising arrangement as claimed in Claim 3, said servo motor operating an output member for said actuator.

5. A pressure equalising arrangement substantially as described and as shown in the accompanying drawings.

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1429795 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

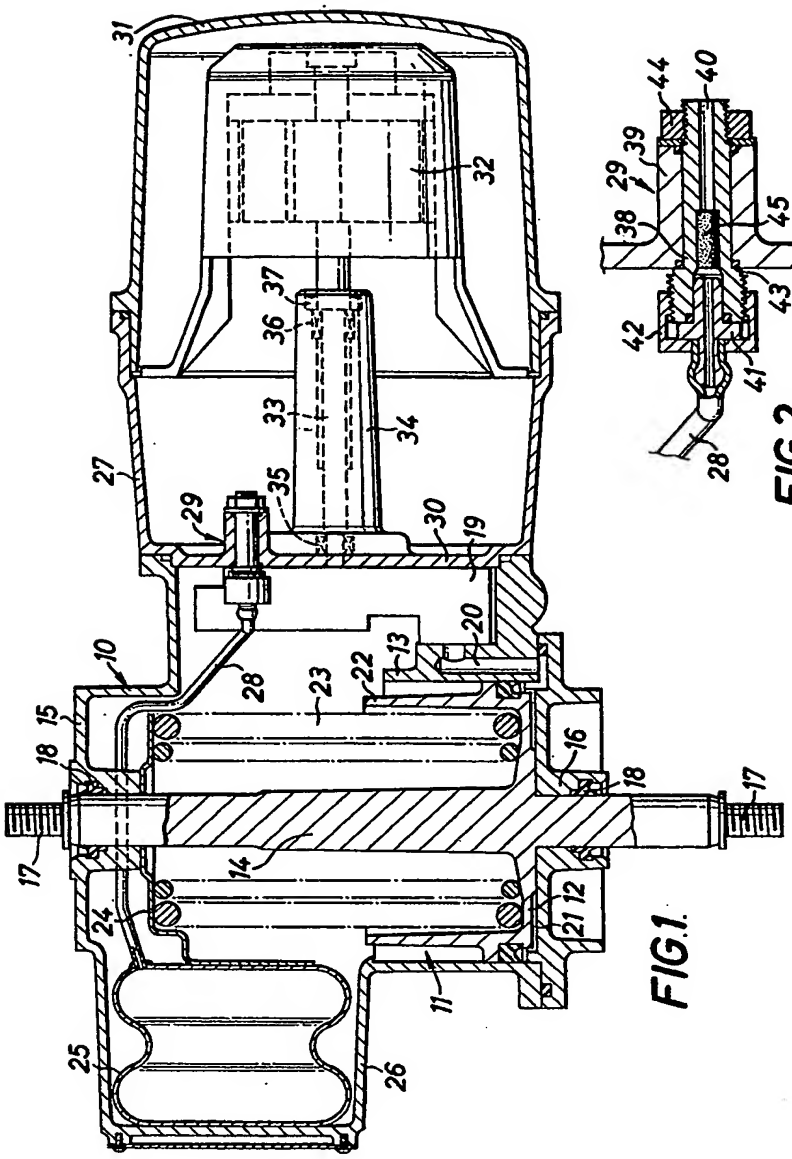

FIG.1.

FIG.2.